DOCUMENT RESUME

ED 147 258 SP 011 394

AUTHOR McKillip, William D.
TITLE CBTE in Elementary Mathematics Methodology.
PUB DATE Sep 75
NOTE 25p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Cognitive Objectives; *Educational Accountability; Elementary Education; Internship Programs; Learning Processes; Learning Theories; *Mathematics; *Methods Courses; *Performance Based Teacher Education; Performance Factors; Problem Solving; Teacher Behavior; Teaching Methods; *Teaching Techniques

ABSTRACT

This document explores some aspects of Competency Based Teacher Education (CBTE) in the area of elementary mathematics teaching methods. The essential and distinguishing features of CBTE are examined. The following topics are discussed in detail: (1) how competencies may be identified; (2) the effects of a competency orientation on methods courses; (3) student teaching and internship experiences; and (4) research trends related to CBTE. In conclusion, the development of a competency is described. The author summarizes the advantages to viewing teacher preparation from the competency orientation. (JD)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED147258

CBTE* IN ELEMENTARY MATHEMATICS METHODOLOGY

William D. McKillip
University of Georgia

September 1975

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
William D. McKillip
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND THE ERIC SYSTEM CONTRACTORS."

In this paper I will explore some aspects of CBTE in the area of elementary mathematics teaching methods. I will examine the essential and distinguishing features of CBTE and some non-essential features and relate them to our University of Georgia experience in this area. I will discuss a "competency" and how competencies may be identified, the effects of a competency orientation on methods courses, student teaching and internship experiences and discuss some research trends related to CBTE. At the conclusion I will describe the development of a competency. While pursuing this article you should be aware that the author is frankly in favor of the "competency" orientation as he views it but certainly is not willing to support all that has been said about what CBTE is or must be.

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

*CBTE, Competency Based Teacher Education.

SP 011 394

Distinguishing Features of CBTE

In a discussion of what CBTE is it is most useful to state what, in an opinion shared by the author, are the essential features of CBTE and to note features which, although many CBTE programs may have them, are not essential. Houston and Howsam (1972) have done this; they list two essential characteristics of CBTE. "Precise learning objectives--defined in behavioral and assessable terms--must be known to learner and teacher alike." (Houston and Howsam, 1972, p. 4). This is really a statement of a goal for clarity of objectives rather than a description of the state of affairs. There are some experiences which have outcomes, we believe, not readily expressible in behavioral terms. There are other objectives whose attainment is a continuum from, say, little skill to much skill; such objectives are not evaluated in the can/can't of a behavioral attainment. Even though there are many exceptions and the present development of goals in teacher education leaves much to be desired, it is worthwhile to strive for the "behavioral" degree of clarity. This striving for clarity will have a positive effect on methods courses, internship, and research as will be discussed later.

The second essential feature discussed by Houston and Howsam (1972, p. 4) is ". . .accountability. The learner knows that he is expected to demonstrate the specified competencies to the required level and in the agreed-upon manner." Thus the student has from the beginning a reasonably accurate (sometimes behavioral) description of what must be done to attain competency

relative to the subject. While college students, in-service teachers and other professors may (and vigorously do) debate one's list of competencies, at least the subject of the debate is plain.

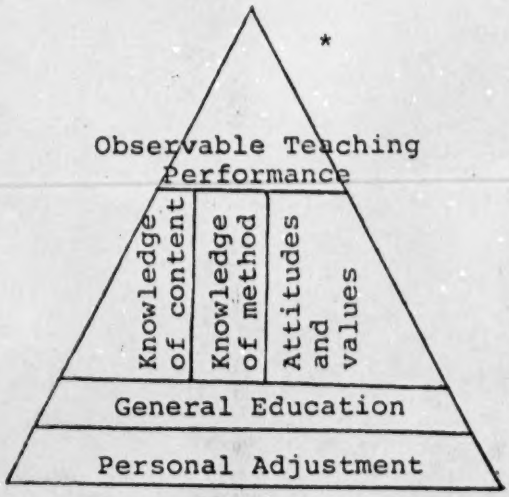
There are many features found in CBTE programs that are not essential to CBTE. These are frequently subject to vigorous attack and since they are not essential, the debate tends to divert discussion from essential and important issues. The most common non-essential features are (a) provision of unlimited time for students to attain objectives, (b) use of a particular system of instruction--large group, small group, etc., (c) use of a particular kind of instructional material: modules, audio visual devices, etc., (d) use of a "systems approach," (e) employment of mastery learning strategies, (f) use of any particular form of administration, control or grading system. In these features, CBTE programs may differ or they may change as conditions dictate.

Houston and Howsam (1974) do not include flexible time for the completion of the program as an essential. Elam (1971) states "Student's progress rate depends on demonstrated competency" and lists this as an essential aspect of CBTE. The University of Georgia CBTE program in mathematics methods operates within a normal latitude of flexibility: An occasional student will complete this course ahead of schedule or be given an "incomplete" to permit further time to attain the competencies.

Competencies

Conceptions of a competency differ in programs with differing orientations. Some definitions of competency tend to emphasize the overt behavior of a teacher in a classroom setting; others focus on the knowledge component in teacher education. The definition we present here attempts to synthesize these two aspects. Any observable teaching performance is (should be?) the result of knowledge, attitudes, and values within the teacher as well as consideration of the particular students whose learning is the object of the teaching performance.

Observable teaching performance is the end result of knowledge of content and methods and appropriate attitudes and values. The things a teacher does in the classroom, the things which can be observed, are determined by and supported by the underlying knowledge and attitudes.



A "competency" is a teaching performance observed in a selection of appropriate situations together with the supporting knowledge and attitudes which enable the teacher to describe how, when,

---

*This figure is adapted from a figure contained in "A Meaning for Competency," C. E. Johnson, G. F. Shearron and N.H. Hensel, University of Georgia, June, 1974, mimeographed.

with whom and for what outcomes to use it. This use of the word "competency" is nearly synonymous with our usual use of the phrase "specific teaching technique," with particular reference to techniques which have specific kinds of learning outcomes.

In planning instruction in a competency one must include knowledge of content and method which enables the teacher to decide when, how and with whom to use the "observable teaching performance." In fact, in lessons presented by interns and by inservice teachers a most frequent observation is that the lesson itself was not bad--possibly very good--but that the decision factors leading to the lesson were mismanaged. The lesson was presented at the wrong time to the wrong group so, quite naturally, results were disappointing. Competency statements which do not include a consideration of these decision factors tend to be superficial.

A competency is "valid" if a teacher who has it and uses it produces the changes in student behavior (learning) which are the intended outcomes associated with the competency. Of course one expects that sometimes for unknown reasons learning will not occur. In this area one must set one's own limits of confidence. The concept of a valid competency is crucial to the development of CBTE. This concept also has important implications for research in CBTE, methods courses, and internship programs.

It is usually agreed that competencies should be derived from the "role" of the teacher. A conception of the role of the teacher in elementary mathematics may be derived from observing teachers, from teaching, from philosophical or psychological theories, or from research findings; commonly all these sources will be considered in developing an extensive list of competencies. Competencies for the teaching of elementary school mathematics are at least partly based on the things teachers do, should do, or should not do in the classroom. When observations of teachers and their students lead to the identification of a substantial and important teacher behavior which is seen to effect students' learning, this behavior and the knowledge, values and attitudes which support it are summarized as a competency. A competency derived in this way has some immediate validity associated with it; at least it has arisen from observation and is to that extent empirical though perhaps not established by formal research.

Theories of learning and philosophical positions on the role and function of a teacher, implications from previous research and analysis of the nature of the content and objectives to be attained all lead to statements of things a teacher should or should not do under various circumstances. These statements, together with the knowledge, values, and attitudes which support them, may be expressed as competencies. These competencies need validation. This is not to argue that the psychological position or previous research is invalid. The

point is to emphasize the need to validate the inferences drawn from a theory that a particular teacher behavior will have a certain effect. Since competencies may be derived from various theoretical positions it is worthwhile to determine whether a particular teacher behavior has the intended effect on students' learning. This is worthwhile from two standpoints. First, confirmation of the predicted outcome is evidence for the theory while nonconfirmation might lead to alteration of the theory. Second, a "competency" which does not produce the intended outcome in practice should be seriously questioned within a competency based (or any other) teacher education program. Only valid competencies should be considered: Time is short!

"Methods" Courses

There are many different kinds of courses taught under the general title "Methods of Teaching Elementary Mathematics." Some courses are organized around a review of elementary mathematics including methods of teaching each topic. In this form of course organization the students are expected to learn more general "methods" of teaching (which would, for example, enable them to plan a presentation of a topic not covered in the course) by generalizing from the individual "methods" presented for each topic. There are potential problems associated with this sort of methods course. It is quite possible that the method for teaching a topic, say the long division algorithm, will be

different from that used in the school in which the student interns or teaches. There is also a problem with variety in method: Some college instructors have a single teaching technique (labs, learning centers, discovery, whatever) which they advocate for every topic. This sort of approach always breaks down in practice because of the necessity for different techniques related to different outcomes and varied techniques simply to combat boredom.

Another way to teach a methods course is to assert that you can't teach methods until content is mastered. . . . "I only have five hours of course work and I have to spend it all teaching them content." Thus, instead of presenting some sensible and effective ways to teach for computational skill or techniques for using concrete materials the college instructor focuses on "a development of the rational numbers as ordered pairs of integers" and frequently does not even relate this to the teaching of fractions. As Rising asserts,

> CUPM-type courses are substituted for methods courses by administrators or, worse still, by teachers who find lecturing on mathematics easier than helping teachers to develop effective mathematical pedagogy." (Rising, 1969, p. 299)

As an aside it should be noted that in this era of shrinking student population and pressure to increase enrollments or to decrease staff, the college of education is a prime target. The argument goes, "Methods courses are not important; the hours should be spent in liberal education. What teachers really need is a firm foundation in content." If we use education courses for content we are in tacit agreement with the argument.

I propose, however, that there is enough substantial content in elementary mathematics methods to fill at least one basic course in the subject. It is my belief that if a college teacher will spend time in public schools, both observing and teaching substantial blocks of content, he will arrive at the conclusion that there is an urgent need for a clear and well organized treatment which relates methods of teaching to anticipated outcomes. One may think of this as a course in "mastering teaching techniques that really work" or "acquiring competencies for effective teaching." The names used are not really important. What is important is that the competencies acquired in the course can be taken into schools, and when used in appropriate situations will usually produce the intended results in terms of student learning. Further, it may be argued that in a methods course the instructor has an obligation to identify teaching techniques which work and then do all he can to insure that students achieve an acceptable level of mastery of these techinques. The degree to which he can <u>insure</u> student mastery depends on circumstances: Time, resources, an internship experience for his students, and so on. The goal is clear, however, and it seems to be a reasonable goal for any course which is about "methods of teaching."

The obligation to present techniques which are effective in attaining certain outcomes extends even to those outcomes which the professor may not approve! As a case in point, there

is a large and well verified group of research findings on how to produce habituated responses, for example memorization of the multiplication facts. (I must assert here that of course meanings and understandings should be firmly established before beginning to work on automatic recall.) This outcome is one which not only has the approval of society but it can be argued that mastery of multiplication facts facilitates exploration of further mathematical topis. The fact that a particular college instructor does not consider this a worthwhile objective does not relieve him of the obligation to include this technique in his course. As stated in a recent report,

> [We] must cooperate to produce mathematics teachers knowledgeable in mathematics, aware of, oriented to, and practiced in a multitude of teaching styles and materials and philosophically prepared to make decisions about the best means to facilitate the . . . mathematics education of their students. (NACOME Report, 1975, p. 139)

To be "aware of" and "practiced in" a multitude of teaching styles is the objective of a methods course whether in CBTE or a traditional program; a teacher is not "prepared to make decisions about" teaching techniques unless a fair presentation is made of the whole range of such techniques.

Methods courses in CBTE programs may be expected to contain a balance of theoretical and applied information. Theory is presented because it supports and explains the performances expected. It supplies the information needed for decisions as to when, how, and with whom to exercise the observable performance. Inferences from the theory should be made clear: Do this, this, and this to obtain that result. Methods in CBTE would be eclectic, using psychological theory.

the nature of the knowledge being taught, research findings, conclusions based on observations of teachers, and whatever other source of information produces descriptions of valid competencies.

Methods courses in CBTE are not necessarily coordinated with internship or student teaching experiences. The attainment of some competencies can be demonstrated without actually teaching children. Simulated teaching, presenting lessons to other college students who play the part of students, can to some extent substitute for an internship experience. It is my experience, however, that these courses are most effective when the students are concurrently working with a class (or better yet a small group) of children in a normal public school setting. The main advantage is improved learning of the teaching techniques. Interns start out with a real group, diagnose their needs, use a specific teaching technique, and observe that the students do in fact learn what they intended. This not only demonstrates convincingly that the intern has acquired the competency but the experience of successfully teaching reinforces and validates the technique for the intern. Without the final step of using it and seeing it work, the competency remains at the level of "theory," easily overlooked in the chaotic experience of beginning teaching.

Another advantage of the internship associated with the methods course is the feedback from classroom work which helps to validate the competencies. In many cases interns collect

data using a pre-and post-test format on a criterion test and convincingly demonstrate that the students have learned. In other cases the results are not as intended. This leads to valuable analysis of the competency and the situation. Was the application ineffective? Does the competency need to be refined, expanded, or generalized? When the topics in a methods course are subject to trial in this way impractical or ineffective suggestions are quickly weeded out. Courses with a limited theoretical orientation or a doctrinaire adherence to a single method of instruction are seen to be inadequate to deal with the complex reality of the classroom.

Teaching such a course is a different experience. If you specify a competency and an intern says--"I just tried this with my group and it didn't work. Can you come out and show me how to do it?" you have to decide what kind of professor you are. Do you have the skills? Do you have the guts? You may find that the classroom is noisy, dusty, not air conditioned, and full of little people who don't react at all as you have been saying they do.

A wider range of more relevant evaluation procedures seem to arise in a competency oriented course than in a traditional course. The following quotation from an article describing the development of the CBTE program in use at Georgia identifies three levels of evaluation.

1. Competency: The teacher can identify four objects in the classroom that could be used as examples of a plane.

Assessment: A straight-forward paper-and-pencil or oral test.

2. Competency: The teacher can work a problem in division of fractional numbers, giving an appropriate reason (explaining, justifying) for each step in the procedure.

Assessment: A simulated teaching situation is used to assess this competency. The instructor may comment or question to determine the adequacy of the knowledge on which the performance is based.

3. Competency: Given a group of children, the teacher can identify the topics on which drill would be effective (for those children) and plan and carry out an effective drill program.

Assessment: In this case the teacher works with children. The assessment of the effectiveness of her work is the degree to which the children achieve the objectives set for them. Thus the teacher, with guidance from the instructor, diagnoses the need for drill and uses appropriate pretests and posttests to determine the effectiveness of her teaching. Until she has demonstrated that her diagnosis and teaching achieve the desired results she has not acquired this competency.

The competencies and assessment procedures, as can be seen in the foregoing examples, range from knowledge, evaluated through simple paper-and-pencil tests, to complex diagnosis and teaching behaviors evaluated by determining their effect on children's learning. (Brown, et al., 1974, p. 221-2)

Houston and Howsom (1972, p. 6, 7) identify such objectives as cognitive, performance, and consequence objectives and suggest the same evaluation schemes.

Cost of CBTE

The cost of CBTE programs in general and of a methods course with an associated internship in particular is higher than the cost of a traditional course. With as many as 20 students in class, the opportunity for simulated teaching practice is limited and the instructor will not be able to observe teaching in the internship as frequently as he would like. A ratio of 1-30 is really out of the question. 1-15 is nearer to the ratio needed for an effective class.

With fewer teachers needed now there seems to be every reason to have smaller classes with greater emphasis on quality. The quality of our product should be improved through rigorous selection and intensive training.

CBTE Internship and Student Teaching

The organization of activities in an internship experience centers around practice of the competencies which have been developed in college classrooms. A "gradual assumption of teaching duties" can be expressed as a well defined series of steps from individual tutoring to group instruction and as a series of competencies to be demonstrated. The competencies are ordered so that the most simple, that is, those in which the objectives and techniques are easiest to understand, are placed early in the internship experience and those which are more complex are placed late in the sequence. At the end, the intern uses all the competencies together, planning and carrying out the total mathematics program for her group for a period of weeks.

The competencies which students are expected to attain also provide a structure for their observations of the experienced teacher to whom they are assigned. Instead of just "observing," they have an organizational framework of student objectives and teaching techniques in which to fit observations. Interns recognize strong and weak areas of instruction; "Mrs. Jones is doing an effective job with computational skill but she ignores verbal problems." Or, sometimes, "Mrs. Smith is doing an excellent job in teaching meanings using a technique not described in any competency. Where do we learn that?"

In addition to organizing the teaching responsibilities and observations of the interns, a competency orientation helps the supervising teacher to improve her teaching by acquiring techniques she has not previously used. When a supervising teacher is aware that, for example, dealing with verbal problems is a technique that the intern is to observe and then demonstrate she will make an extra effort to acquire competency with that technique.

Of course, the benefits of competency organization are only realized if the competencies are valid. They must be such that, when implemented in appropriate situations in the schools, they reliably produce the intended result in terms of student learning. This should not be surprising, as it is after all the basic purpose of teacher education.

Research

There are a variety of questions which should be answered in connection with CBTE programs. Before progressing with the research aspects of CBTE, however, two preliminary statements are in order. It is not necessary, in advocating CBTE, to produce research showing that CBTE is better than or even as good as existing programs. The non-CBTE programs in existence are not based on research and did not displace programs which preceded them because they were proved better. In view of the criticism regularly leveled at our methods courses we would be remiss in not seeking alternatives. Any well thought out, carefully implemented CBTE program incorporating those validated competencies which we can identify stands an excellent chance of being an improvement on the methods course it replaces.

As problems and reservations are discussed, it must be remembered that CBTE does not cause these problems; they become an issue only because of the attempt within CBTE to be quite specific. For example, in a traditional methods course one rarely asks "Specifically what student outcome is intended in the technique you are discussing and do you have experimental evidence that the technique and outcome are causally related?" This question is frequently asked (more or less as a challenge) of CBTE programs. The question is a valid one and one which CBTE advocates should attempt to answer. But one cannot expect all the answers, or very many definitive answers, at first. Surely the way to progress is to ask this question over and

over, relate and synthesize answers and gradually build a collection of carefully validated competencies.

One analysis of the needed research related to CBTE is contained in an article by Brown and others (Brown, 1974, p. 223).

> More extensive evaluation is needed and deeper questions remain to be investigated. Are the competencies that have been deemed necessary for adequate teaching of elementary mathematics really necessary? Can evidence be found in children's learning to support or deny the contention that these competencies are necessary? Teachers operate under a wide variety of conditions--class size, intensity of supervision, and internal motivation. Other factors may also be expected to influence their performance. Under what conditions are the competencies that teachers attain in the program evident in the classroom? Is there an observable relation between the attainment of the competencies, their evidence in classroom practice, and student achievement?
>
> The observation that many teachers leave the classroom for a period of years has led the staff to ask about the "half-life" of a competency. Are the competencies acquired for life, do these competencies need periodic review, or do they need reverification after a period of absence from the profession?

The validation of competencies is an important theme of research related to CBTE, as one might suspect, since the relation between the performance of the competency and student learning outcomes is absolutely central in CBTE and presumably in all methods courses. This and other questions were identified by Medley and Krathwohl (1974).

1. What kinds of teacher competencies produce what kinds of outcomes with what types of pupils?
2. How are these relationships affected by entering characteristics of pupils and curriculum variables, and how do they interact with teacher behaviors?

3. Is it possible to isolate the effects of teacher behavior from other environmental factors?

4. What are some of these other variables?

5. Is there enough known correlation between competencies and outcomes to justify certification on the basis of competencies?

6. Which kinds of outcomes are most reliably measured at the preservice level? at the inservice level?

7. Are there competencies which once acquired are never lost? Are there competencies which need continual reinforcement and practice to be maintained?

It is interesting to note that there is one competency on which a very substantial amount of research has been conducted in attempts to assess its validity. The competency, of course, is knoweldge of subject matter. Logically, knowledge of subject matter should be positively correlated with student learning: Teachers who know more mathematics should be better teachers (get students to learn more) than teachers who know less mathematics. This is an assumption but we have invested and are investing huge sums of money as though it were a fact. Consider the expenditures for NSF institutes and the mathematics courses offered for and taken by teachers on the assumption that these courses make them better teachers.

It is quite striking to review the actual evidence related to this assumption. James Fey, writing in the review of educational research (Fey, 1969, p. 540), says

> Studies by Lampela (1966), Rouse (1967), and Smith (1964) confirmed the conclusion that predictors of elementary school mathematics teaching success will not be found among the obvious variables of experience, academic preparation, and mathematical knowledge. It might be that the mathematical knowledge of elementary teachers is uniformly so low that it does not play an important role in effectiveness.

The search for valid competencies and the validation of proposed competencies is worth the effort. Gage (1974) has analyzed the current state of that effort and concludes

> So far, I have defended the search for the kind of relationship [that of teacher behavior to student learning] that will make performance based teacher education truly advantageous. I have defended the search against logical or conceptual attacks, against methodological criticisms, against premature discouragement, and against complacency about current approaches. I believe performance based teacher education should go on, even before the research successes that we seek have been won, because even without the fruits of such research it provides a tremendous heuristic advance over conventional teacher education. It exposes the questions we need to ask, and it proceeds in an optimal way on the basis of what knowledge about teacher competencies is now available.

Development of a Competency

An example of the development and implementation of the approach is undoubtedly in order. How does this development and implementation differ from a traditional course? The answer to that depends on the traditional course: Some have always been based on "techniques that work" while others have been almost completely inapplicable. Let us take a competency and describe the way in which it is developed and applied. Here are two competencies selected from a list related to teaching for problem solving skill.

> Given a topic in elementary school mathematics the teacher can plan a problem solving program designed to increase children's skill in solving routine story problems. . . .
>
> For a child, or a small group of children, the teacher can carry out a program of problem solving activities with the children. (McKillip, et al., 1975).

To what extent can we claim that these competencies are valid? Research on problem solving, extending back over forty years, supports the claim that problem solving by students should be a frequent part of class activities. Systematic observations in a large city system supported two contentions: Few teachers do problem solving frequently and those who have frequent problem solving activities produce better results than those who do not. Interns who plan and carry out systematic problem solving activities achieve, in almost all cases, the results intended. Attainment of the stated competencies seems to be a valid goal for teachers.

What knowledge of content, knowledge of method, and attitudes and values are necessary or desirable to support those competencies? We first note that many inservice and preservice elementary school teachers have very negative attitudes toward problem solving in general and "story" problems in particular. These attitudes are rooted in their own school experiences and influence not only the way they feel about teaching story problems but also how they, in fact, go about teaching them. The first objective of instruction is to improve attitudes. This process is <u>begun</u> through assignment of some interesting non-routine problems which, while not simple, have minimum mathematical prerequisites and can be worked by a variety of strategies including trial and error. From this point on students are in continuous interaction with problems and build

not only power but also positive attitudes. As students work on problems individually, in groups, and as a class, great care is taken to use techniques which exemplify those the students are to acquire. Techniques based on Polya's work are made objects of explicit discussion so that the students are conscious that modeling is to take place.

Mathematical content is not specifically treated in this context except the skill of problem solving, which is treated as described in the preceding paragraph. If a student finds himself deficient in particular mathematical content he may, of course, look it up in any one of a variety of sources or get help from the instructor.

Knowledge of methodology is carefully developed in written material as well as through lecture-discussion and examples of problem solving teaching behavior. The details of the methodology are too extensive to reproduce here but a few examples are given.

a. Teach one problem each day, at least assigning, working and explaining it. This simple maxim is supported by research yet many teachers do not practice it and many methods courses ignore this sort of simple but effective "rule of thumb."
b. Assign problems which students can work. Build up to harder problems from a history of success on easy problems.

c. Make problems easier by changing (i) vocabulary and sentence structure, (ii) context or (iii) numbers.

A variety of other examples can be given. Heuristic strategies are emphasized in dealing with all problem solving activities. Comprehension of this material and the implementation of the competency may be on many levels. Some students fully grasp the power of the heuristic strategies and are able to use them effectively with pupils; others see some value in heuristics and are, for example, aware that the student should understand the problem before attempting to solve it. All must attain minimum competence necessary to teach the verbal problems in elementary mathematics textbooks effectively.

Frankly, that was our goal: Equipping every teacher with the known "techniques that work," or competencies. There will still be differences in the skill with which teachers perform in the classroom, in the depth of their understanding and in the achievement of their students. This will still present a problem, because these differences do exist in <u>degree</u> and not, simplistically, as a "yes or no" evaluation. To define a cut-off point below which a teacher is judged not to possess the competency to a sufficient degree is difficult.

In summary we list the advantages to viewing teacher preparation from the competency orientation.

1. A competency approach has a beneficial effect on methods courses, tending to make them more applicable and ensuring that whatever hard practical information we have is included.

2. A competency approach has a beneficial effect on the professor.

3. A competency approach tends to organize and focus the efforts of all parties in an internship situation: Interns, supervising teachers and college supervisors know what techniques should be evident in the classroom.

4. The general interest in competencies, and in particular, in valid competencies, is within an already established line of research and offers new impetus to that line.

As the reader must be aware, our experience with CBTE has been quite positive. We feel that this positive experience has been a result of concentrating on the basics of CBTE and structuring it in terms of our background as mathematics educators.

REFERENCES

Brown, O. Robert, Morrison, R. Ruel, Byrne, Mary Ann, Cooney, Thomas J., Davis, Edward J., Mahaffey, Michael L., McKillip, William D., & Wilson, James W. Developing a "competency-based" teacher education program: a report on a project. The Arithmetic Teacher, March 1974, Vol. 21, No. 3, 220-223.

Elam, Stanley. Performance-based teacher education: What is the state of the art? Washington, D.C.: American Association of Colleges for Teacher Education, December, 1971, 8.

Fey, James. Classroom teaching of mathematics. Review of educational research, Vol. 39, No. 4, October 1969, 535-551

Gage, N. L. Evaluating ways to help teachers to behave desirably. Competency, Assessment, Research, and Evaluation. A report of a National Conference, University of Houston, March 12-15, 1974, 173-185.

Howsam, Robert B. & Houston, W. Robert (Eds.). Change and challenge. Competency-based teacher education. Chicago: Science Research Associates, 1972, 1-16.

Johnson, Charles E., Shearron, Gilbert F., & Hensel, Nancy H. A meaning for competency. University of Georgia, June 1974, mimeographed.

McKillip, William D., Cooney, Thomas J., Davis, Edward J., & Wilson, James W. Teaching for problem solving skill. Unpublished manuscript, University of Georgia, 1975.

Medley, Donald M. & Krathwohl, David. Task force on relating teacher competence to pupil outcomes. Competency, Assessment, Research, and Evaluation. A report of a National Conference, University of Houston, March 12-15, 1974, 82-87.

National Advisory Committee on Mathematical Education (NACOME). Overview and analysis of school mathematics, Grades K-12. Published by the Conference Board of the Mathematical Sciences, Washington, D.C., 1975, 139. (Prepared with the support of the National Science Foundation.)

Rising, Gerald R. The Sorry State of Mathematics Teacher Education. The Arithmetic Teacher, April 1969, Vol. 16, No. 4, 296-300.